FEM MODELING OF NANOINDENTATION EXPERIMENT FOR NANOSTRUCTURAL N – CARBON FILM (N- PD, NI)

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This work presents a comparison of numerical simulation and experimental data for nanoindentation studies of nanostructural Pd/Ni-carbonaceous films. Nanoindentation experiments are performed with a tip made of diamond with a shape of a 90° cube corner three-sided pyramid in a Hysitron Triboscope. The tip radius was determined with about 321 nm by calibration with a sharp silicon grid. Films containing palladium or nickel nanograins embedded in a carbonaceous matrix are investigated. The local hardness values reflect the nanosize grain structure and give values of about 3 GPa for very hard particles embedded in a soft matrix with 0.5 GPa. Details of the mechanical deformation of the heterogeneous material on nanoscale during indentation are displayed in the load-displacement curves with typical pop-ins and hysteresis loops.

The finite element method (FEM) is used to model the indentation in such a heterogeneous material on nanoscale. The modeling was performed with the ANSYS program package (Ansys, Inc) using the traditional Oliver–Pharr method and a spherically shaped tip. FEM allows to study the mechanical properties for these nano-composite films. The simulations result in typical load-displacement curves with the corresponding deformation fields of stress and strain in the material.